UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Note to Reader

Background: As part of its effort to involve the public in the implementation of the Food Quality Protection Act of 1996 (FQPA), which is designed to ensure that the United States continues to have the safest and most abundant food supply. EPA is undertaking an effort to open public dockets on the organophosphate pesticides. These dockets will make available to all interested parties documents that were developed as part of the U.S. Environmental Protection Agency's process for making reregistration eligibility decisions and tolerance reassessments consistent with FQPA. The dockets include preliminary health assessments and, where available, ecological risk assessments conducted by EPA, rebuttals or corrections to the risk assessments submitted by chemical registrants, and the Agency's response to the registrants' submissions.

The analyses contained in this docket are preliminary in nature and represent the information available to EPA at the time they were prepared. Additional information may have been submitted to EPA which has not yet been incorporated into these analyses, and registrants or others may be developing relevant information. It's common and appropriate that new information and analyses will be used to revise and refine the evaluations contained in these dockets to make them more comprehensive and realistic. The Agency cautions against premature conclusions based on these preliminary assessments and against any use of information contained in these documents out of their full context. Throughout this process, If unacceptable risks are identified, EPA will act to reduce or eliminate the risks.

There is a 60 day comment period in which the public and all interested parties are invited to submit comments on the information in this docket. Comments should directly relate to this organophosphate and to the information and issues available in the information docket. Once the comment period closes, EPA will review all comments and revise the risk assessments, as necessary.

These preliminary risk assessments represent an early stage in the process by which EPA is evaluating the regulatory requirements applicable to existing pesticides. Through this opportunity for notice and comment, the Agency hopes to advance the openness and scientific soundness underpinning its decisions. This process is designed to assure that America continues to enjoy the safest and most abundant food supply. Through implementation of EPA's tolerance reassessment program under the Food Quality Protection Act, the food supply will become even safer. Leading health experts recommend that all people eat a wide variety of foods, including at least five servings of fruits and vegetables a day.

Note: This sheet is provided to help the reader understand how refined and developed the pesticide file is as of the date prepared, what if any changes have occurred recently, and what new information, if any, is expected to be included in the analysis before decisions are made. **It is not meant to be a summary of all current information regarding the chemical.** Rather, the sheet provides some context to better understand the substantive material in the docket (RED chapters, registrant rebuttals, Agency responses to rebuttals, etc.) for this pesticide.

Further, in some cases, differences may be noted between the RED chapters and the Agency's comprehensive reports on the hazard identification information and safety factors for all organophosphates. In these cases, information in the comprehensive reports is the most current and will, barring the submission of more data that the Agency finds useful, be used in the risk assessments.

Jack E. Housenger, Acting Director
Special Review and Reregistration Division

August 13, 1999

SUBJECT: DISLODGEABLE FOLIAR RESIDUES AND EXPOSURE ASSESSMENT
                    FOR RESIDENTIAL/RECREATIONAL TURF APPLICATIONS OF
                    DICHLORVOS (DDVP), PC Code 084001, Barcodes D248456, D248596,
                    D255253

FROM: David Jaquith
                    Reregistration Action Branch 4
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TO: Kimberly Lowe
                    Special Review and Reregistration Division (7508C)

THRU: Sue Hummel, Senior Scientist
                    Reregistration Action Branch 4
                    Health Effects Division (7509C)

Please find below the RRAB4 review of ....

DP Barcodes: D248456, D248596, D255253 Pesticide Chemical Code: 084001

EPA Reg. No.:   5481-205

Deferral to:

PHED: N/A

1.0 INTRODUCTION

AMVAC Chemical Company has submitted three studies measuring the dislodgeable foliar residues (DFRs) and air concentrations of DDVP following application to turf.

2.0 CONCLUSIONS

RRAB4 has revised a previous exposure assessment (1,2) for individuals reentering residential/recreational turf treated with Dichlorvos spray at a rate of 0.5 lbs ai per acre. The previous estimate merged a literature dislodgeable foliar residue study with a registrant submitted study monitoring individuals performing JAZZERCISE activities on carpets (3). Respiratory exposure was considered to be negligible compared to other routes.

The current estimates are derived from three foliar residue studies submitted by the registrant, the above mentioned carpet study, and the residential SOPs where necessary. Studies were conducted in California, Florida, and Ontario. The levels of DDVP were measured using a roller technique developed by CALEPA. The levels found by this method were appreciably lower than those from the literature study, possibly due to the sampling method. In order to extrapolate from the carpet study to adjust for these lower amounts, a linear regression equation (presented in Figure 6) was derived and exposure estimates were obtained from this equation. At levels where the equation predicted exposures slightly less than 0, the exposure was considered negligible and dermal exposure was not added to the oral component.

The air monitoring portions of the studies were not reported in a fashion that allowed their use for exposure assessment but appear to support the assumption that in the outdoor environment, respiratory exposure for this scenario does not contribute appreciably to the total exposure.

Estimates were calculated assuming that an individual performs activities for 2 hour per day, one occurring one hour after application and the other 2 hours after treatment. Oral exposure from hand to mouth activity and dermal exposure estimates were obtained for each interval and summed to yield a total daily exposure. The total transferable residues (TTRs), estimates of oral and dermal exposure for each interval, total daily exposures and resulting Margins of Exposure (MOEs) are presented in Table 1. A NOAEL of 0.1 mg/kg/day was used for MOE calculation. MOEs at the Ontario site were all less than 100, ranging from 26 to 34. The California and Florida sites yielded MOEs between 180 and 1200.

Table 1. **Estimates of the Daily Oral Exposure from Hand to Mouth Activity and Dermal Exposures of Individuals Performing Activities on Turf Treated with DDVP at a Rate of 0.5 lb per Acre. Individuals are assumed to spend 2 hours per day, on occurring one hour after treatment and one two hours after treatment.**

Location	TTRs (ng/cm²)		Hand to Mouth[1] Exposure (µg/kg/day)		Dermal Exposure[2] (µg/kg/day)		Total (µg/kg/day)	MOE
	After 1 Hour	After 2 Hrs	After 1 Hour	After 2 Hrs	After 1 Hour	After 2 Hours		
CA	5.34	0.68	0.194	0.025	0.344	Negligible[3]	0.56	180
	3.94	0.73	0.143	0.027	0.183	Negligible	0.35	280
	4.75	0.55	0.173	0.020	0.276	Negligible	0.47	210
Mean	4.68	0.65	0.17	0.024	0.268	Negligible	0.46	220
FLA	1.29	1.52	0.047	0.055	Negligible	Negligible	0.10	1000
	1.52	0.71	0.055	0.026	Negligible	Negligible	0.081	1200
	1.86	1.22	0.068	0.044	Negligible	Negligible	0.11	910
Mean	1.56	1.15	0.057	0.042	Negligible	Negligible	0.099	1000
ONT	23.73	5.79	0.864	0.211	2.459	0.396	3.9	26
	24.28	3.3	0.884	0.12	2.523	0.109	3.6	28
	18.47	4.4	0.672	0.16	1.854	0.236	2.9	34
Mean	22.16	4.5	0.807	0.16	2.279	0.248	3.5	29

[1] Hand to mouth exposure = $\dfrac{\text{TTR (ng/cm}^2) \times 350 \text{ cm}^2 \times 1.56 \text{ activities/hr} \times 2 \text{ hr/day}}{1000 \text{ ng/µg} \times 15 \text{ kg body weight}}$

[2] Dermal Exposure = $\dfrac{[\text{TTR (ng/cm}^2) \div 1000 \text{ ng/µg} \times 24400 - 57.3] \times 0.11 \times 20 \text{ min/activity} \times 3 \text{ activities/hr}}{70 \text{ kg}}$

[3] Negligible means that extrapolation using the regression equation from the carpet study yields a value slightly less than 0; considered to be no exposure.

3.0 DETAILED CONSIDERATIONS

3.1 Study Design

The three studies had similar designs and were carried out at three different locations, California, Florida, and Ontario. The citations are:

Determination of Transferable Turf Residues on Turf Treated with Dichlorvos in California. MRID No. 445919-01, DP Code D248456.

Determination of Transferable Turf Residues on Turf Treated with Dichlorvos in Florida. MRID No. 446105-01, DP Code D248596.

Determination of Transferable Turf Residues on Turf Treated with Dichlorvos in Ontario, Canada. MRID No. 447949-01, DP Code D255253.

3.1.1 Study Site and Application Parameters

An emulsifiable formulation of DDVP (DDVP 2E, EPA Reg. No. 5481-205, 2 lbs ai/gallon) was applied during each study. The insecticide was applied at a rate of 2 pints per acre (0.5 lb ai/A). Two foliar broadcast applications, one week apart, were made at each site. Applications in California were made using a tractor mounted boom spray. In Florida and Ontario backpack sprayers were used.

The California study site was divided into 4 rows, each containing 10 subplots (5 ft x 6 ft). The Florida site consisted of 8 paired rows each containing 14 subplots (4 ft x 6 ft). The Ontario site also consisted of 8 paired rows each containing 14 subplots (5 ft x 6.6 ft). Untreated walkways separated the treated rows. Control plots were established 101-1000 ft from the treated areas.

3.1.2 Total Residues on Turf

Total residues on the turf were collected at the Florida and Ontario sites only. Duplicate grass clippings were collected at intervals of 1, 2, 4, and 8 hours after the last application. The samples were stored in a cooler with dry ice and either shipped the same day or stored in a walk-in freezer until shipment.

Grass samples were maintained frozen until analysis. A 10 gram sample was placed in an 8 ounce jar and extracted with 150 mL of ethyl acetate using a Polytron blender. The extract was filtered through a Büchner funnel and 2 drops of tetradecane added. The sample was evaporated to dryness and 5 mL of ethyl acetate added to the flask. An aliquot was analyzed by gas chromatography with a flame photometric detector in the phosphorus mode. If necessary, the sample was further diluted to be within the

linear range of the standard curve. The amount of analyte in the sample was calculated using the following equation:

$$\text{ppm DDVP} = \frac{\text{Conc DDVP in aliquot (µg/mL)} \times \text{extract vol. (mL)} \times \text{Dilution factor}}{\text{Weight of sample (g)}}$$

The results of total residue sampling are presented in Figure 1 and Appendix A.

3.1.3 Transferable Residues

The amount of transferable DDVP residue on turf (Total Transferable Residue, TTR) was determined by a roller sampling method. Cloth samples (27 in × 39 in) were placed under a 30 inch × 40 inch frame and covered with plastic. A 32-pound roller was then passed over the plastic 5 times. The cloth was uncovered, placed in a plastic bag, sealed, and placed over ice. The samples were frozen until analysis. Samples were collected immediately after treatment and at intervals of 0, 2, 4, 8, 12, 24, 48, and 72 or 96 hours after the second application. Only data from the second application of two applications (one week apart) were used for exposure assessment.

3.1.4 Air Sampling

Air samples were collected using samplers located in the middle of the walkway at the center of the treated plot matrix. Samples were collected at heights of 18 and 36 inches by drawing air at a rate of 2 liters per minute through tubes containing XAD-2 resin as the trapping agent. Duplicate samples were collected at each height immediately after treatment and at intervals of 2, 4, 8, 12, 24, 48, and 72 or 96 hours after the second application.

The XAD-2 tubes were kept frozen until analysis. Front and back sections were removed separately from the tubes and quantitatively transferred to a 20 mL scintillation vial. two mL of toluene (acetonitrile in the California study) was added and the capped vial shaken for approximately 1 minute and again intermittently for the next hour. The sample was then filtered through a 45 µm Acrodisc®. An aliquot was taken and analyzed by gas chromatography with a flame photometric detector in the phosphorus mode. If necessary, the sample was further diluted to be within the linear range of the standard curve. The amount of analyte in the sample was calculated using the following equation:

$$\text{µg DDVP} = \text{Conc DDVP in aliquot (µg/mL)} \times \text{extract vol. (mL)} \times \text{Dilution factor}$$

The registrant then performed the following series of calculations:

Total amount of Dichlorvos Applied to the Test System:

Using the California study as an example:

$$\mu g \; DDVP = 0.497 \; lb \; ai/A \times 0.0459 \; A \times 453.6 \; g/lb \times 10^6 \; \mu g/lb$$

$$= 1.03 \times 10^7 \; \mu g \; applied$$

Volume of air in column above test system sampled by air filters:

Two assumptions were used for this calculation; 1) one half of the plot was sampled by each air filter regardless of wind direction because the air samplers were located in the center of the treated plot; 2) the low position air filter (18 inches) sampled from the ground to half the distance to the high air filter (36 inches) and that the high air filter sampled from half the distance to the low filter to an equal distance above the air filter. The air volume was then calculated:

$$Volume \; (cm^3) = \frac{H \times A}{k}$$

where:

H = Height of column (2.54 cm/in × 27 in) = 68.5 cm
A = Area of air column sampled = (50 ft) × (40 ft) × 929 cm²/ft² = 9.29×10^5 cm²
k = 1000 cm³/L

$$Volume \; (cm^3) = \frac{68.5 \; cm \times (9.29 \times 10^5) \; cm^2}{1000 \; cm^3/L} = 6.36 \times 10^4 \; L$$

Time needed for air to cross the test system:

The air filters were calibrated to sample at a rate of 2 L/min. This information was combined with an estimate of the time required for air to cross from the edge of the test system to the sampling units, based on the average wind speed during the sampling interval. The time for air to travel from the edge of the treatment area to the sampler is:

$$t \; (min) = \frac{Average \; distance \; from \; edge \; of \; treatment \; area \; (ft)}{air \; flow \; rate \; (ft/min)}$$

The following table was presented by the registrant:

Sampling Interval	Average Air Flow Rate (mph)	Average Air Flow Rate (ft/min)	Average ft from Edge of Area	Average time for Air to Cross Treated Area, t (min)
1 hr	3.9	343	29.19	0.085
2 hr	4.2	369.6	31.28	0.085
4 hr	3.2	281.6	30.23	0.107
8 hr	2.7	237.6	30.02	0.126
12 hr	0.45	39.6	33.38	0.843
16 hr	0.13	11.44	33.38	2.918

The registrant then calculated the total volumes that the air samplers collected at each interval as follows:

Volume (L) = Average Air Flow Rate to cross treatment area (ft/min) × t (min)

Sampling Interval	Sampling Flow Rate (L/min)	t (min)	Volume (L)
1 hr	2	0.085	0.170
2 hr	2	0.085	0.170
4 hr	2	0.107	0.214
8 hr	2	0.126	0.252
12 hr	2	0.843	1.686
16 hr	2	2.918	5.836

The total amount of DDVP collected was then calculated:

Total DDVP (µg) = $\dfrac{\text{DDVP residue on filters (µg)} \times \text{volume of air in column above test system}}{\text{Liters of air collected by air filters in time it took to cross the test system}}$

The following table resulted from these calculations:

Air Sampler Position	Interval (hr)	Avg µg on Individual Filters	Volume of Air in Column above Test System (L)	Volume of air collected by air filters in time it took to cross the test system (L)	Mass of DDVP Collected by Air Filters	Percent of Total DDVP Applied to Test System
Low	1	0.984	127426	0.170	737570	7.13
High	1	0.157	127426	0.170	117681	1.14
Low	2	0.376	127426	0.170	281835	2.72
High	2	0.050	127426	0.170	37478	0.36
Low	4	0.228	127426	0.214	135762	1.31
High	4	0.050	127426	0.214	29772	0.29
	8	0.070	127426	0.252	35396	0.34
Low	8	0.050	127426	0.252	25283	0.24
High						
Low	12	0.050	127426	1.686	3779	0.04
High	12	0.050	127426	1.686	3779	0.04
Low	16	0.050	127426	5.836	1092	0.01
High	16	0.050	127426	5.836	1092	0.01
Totals				Low	1195434	11.55
				High	215085	2.08
				Total	1410519	

The above values are for the California study only. Similar calculations were performed for the Florida and Ontario sites.

3.2 Results

The total residues of DDVP on treated turf are summarized in Figure 1. The numerical values are tabulated in Appendix A. The data were fitted to a first order decay equation of the form:

$$\text{DDVP Residues (ppm)} = \text{Initial Residues (ppm)} \times e^{-k(t,hrs)}$$

Using the combined values from Florida and Ontario this becomes:

$$\text{DDVP Residues (ppm)} = 10.2 \text{ ppm} \times e^{-0.33t(hrs)}$$

$$r^2 = 0.87$$

The results of the transferable residue sampling are presented in Figures 2, 3, and 4 for California, Florida, and Ontario, respectively. The data for the sites combined are presented in Figure 5. The exponential regression analyses are presented for each site in Table 2. The fit of the data to an exponential decay equation is rather poor for this test system. Examination of the graphs indicates that the dissipation pattern of DDVP on turf is probably biphasic, with an initial drop in concentration as the material dries (formulation effects) followed by a more gradual decline as the material weathers. The TTR values are presented in Table 3.

Table 2. Summary of Exponential Decay Equations for Total Transferable Residues (TTR) of Dichlorvos (DDVP) on Turf Treated at a Rate of 0.5 lb ai/A. The Equation is of the form $C_t = C_o e^{-kt}$.			
Site	**C_o (ng/cm²)**	**k**	**r^2**
California	1.06	0.058	0.595
Florida	0.57	0.0497	0.633
Ontario	0.85	0.0541	0.288
Combined	0.79	0.052	0.423

Table 3. Total Transferable Residues (TTRs) for Dichlorvos (DDVP) on Turf from Three Locations Following Treatment at a Rate of 0.5 lb ai/A.

Site	TTR (ng/cm²)							
	1 Hr	2 Hrs	4 Hrs	8 Hrs	12 Hrs	24 Hrs	48 Hrs	72 Hrs
California	5.34	0.68	0.26	0.09	2.5	0.5	ND	ND
	3.94	0.73	0.23	0.10	2.04	0.29	ND	ND
	4.75	0.55	0.21	0.19	3.12	0.29	ND	ND
MEAN	4.7	0.65	0.23	0.13	2.6	0.36	ND	ND
Florida	1.29	1.52	0.34	0.11	0.22	0.02	ND	ND
	1.52	0.71	0.49	0.16	0.23	0.01	ND	ND
	1.86	1.22	0.38	0.09	0.28	0.02	ND	ND
MEAN	1.6	1.2	0.40	0.12	0.24	0.02	ND	ND
Ontario	23.73	5.8	0.13	ND	ND	2.16	ND	ND
	24.28	3.3	0.17	ND	ND	0.23	ND	ND
	18.47	4.4	0.13	ND	ND	0.32	ND	ND
MEAN	22.2	4.5	0.14	ND	ND	0.89	ND	ND[2]

[1] ND = Non Detect at a level of 0.088 ng/cm².

[2] Sample at Ontario site was collected at an interval of 96 hours.

3.3 Calculation of Exposures

The exposure estimates required a number of assumptions:

The Agency has no data measuring exposures of children to DDVP and, when chemical specific information was not available, has estimated the contribution of this route using default assumptions and calculations from the Residential Standard Operating Procedures (4). The relevant section is presented in Appendix B. Because some chemical specific data were available, not all default assumptions were used to estimate DDVP exposure. The following assumptions were used:

1) A toddler weighs 15 kg.

2) The surface area of the hand of a toddler is 350 cm².

3) There are 1.56 hand to mouth activities per hour.

4) The amount of residue transferred to the hand is equal to the amount on the treated turf.

5) Activities on treated turf occur for 2 hours per day. One of these occurs at the level measured one hour after treatment and the other at that measured 2 hours after treatment. **This should be considered to be conservative because it does not address the dissipation of the material during the activity period itself.** It is also conservative in that it assumes that activities begin soon after the application. It is common the require that the area be vacated until the turf is dry, often a period of 2 hours.

6) The dermal exposure of a child performing Jazzercise is the same as that of an adult performing the same activity, **ON A MG PER KG BASIS**.

7) Dermal absorption is 11 percent (5).

8) The NOAEL is 0.1 mg/kg/day for short term exposure (100 µg/kg/day).

3.3.1 Dermal Exposure from Activities on Turf

HED has previously calculated estimates of the exposures of individuals performing activities on turf treated with DDVP (1,2). The exposure estimates were derived from a study in the scientific literature for the dislodgeable foliar residues (DFR) and a resident submitted study measuring exposures of individuals performing activities following actuation of a total release fogger (3). The fogger study monitored the exposures of individuals performing JAZZERCISE® routines at intervals following actuation of the

fogger and one hour of passive aeration. Exposures were monitored for intervals up to 15 hours after application. The dislodgeable residues and resulting dermal exposures from the indoor study are presented in Table 4.

Table 4.   Mean Concentrations of DDVP Found on Carpet Wipes and Dosimeter Clothing at Various Times After Actuation of a Total Release Fogger.

Sampling Interval (hrs after trt)	Carpet Wipes ($\mu g/cm^2$)	Mean of Total μg found on Clothing
3	0.039	883
4.5	NS	
5	NS	
6	0.030	661
8	NS	
9	0.022	558
11	NS	
12	NS	
15	0.016	281
17	NS	

An interval of 2 hours before reentry was used for the previous assessment. This approximates the amount of time required for drying of the spray, which is label-required before reentry in some cases. The residue levels determined on the carpet at this interval were close to those measured on treated lawns. The current submissions, using a different monitoring method, measured appreciably lower levels of DDVP on the treated turf. The current assessment is adjusted for the difference in measured levels of DDVP. The total transferable DDVP levels found on turf from each location are presented in Table 3. One hour after treatment the average residues were 4.7 ng/cm² (0.0047 µg/cm²), 1.6 ng/cm² (0.0016 µg/cm²), and 22.2 ng/cm² (0.022 µg/cm²) for California, Florida, and Ontario, respectively.

Data from the carpet study, presented in Table 4 and graphically in Figure 6, indicate that at a residue level of 0.022 µg/cm² the exposure following 20 minutes of Jazzercise was 558 µg (0.87 µg/kg for a 70 kg individual using 11 percent dermal absorption). A linear regression was used to extrapolate to lower residue levels. The linear regression equation describing exposure as a function of residue levels was:

$$\text{Exposure (µg)} = -57.3 \text{ µg/cm}^2 + (2.44 \times 10^4) \times \text{µg/cm}^2 \times 0.11$$

The Coefficient of Determination (r^2) for this equation was 0.95. Using the mean values from Florida and California as examples in the equation this equation the estimated exposures resulting from residue levels of 0.0016 µg/cm² and 0.0047 µg/cm² would be expected to be:

$$\text{Exposure (µg)} = -57.3 \text{ µg/cm}^2 + (2.44 \times 10^4) \times 0.0016 \text{ µg/cm}^2 \times 0.11 = -2 \text{ µg}$$

Although negative exposure is not possible, this is considered to be:
$\approx$ 0 µg or negligible exposure

and

$$\text{Exposure (µg)} = -57.3 \text{ µg/cm}^2 + (2.44 \times 10^4) \times 0.0047 \text{ µg/cm}^2 \times 0.11 = 6.3 \text{ µg}$$

or 0.09 µg/kg for a 70 kg individual over a 20 minute activity period.

The exposures resulting from the mean levels of transferable residues for each site were evaluated for each location. Estimates are provided for intervals of 1 hour (essentially immediately after treatment), 2 hours, and 4 hours after treatment.

3.3.2 Estimation of Oral Exposure to DDVP from Hand-to Mouth Transfer

Estimation of oral exposure from hand to mouth activity was conducted using the Agency Residential Standard Operating Procedures (4):

1)   A toddler weighs 15 kg.

2)   The surface area of the hand of a toddler is 350 cm².

3)   There are 1.56 hand to mouth activities per hour.

4)   The amount of residue transferred to the hand is equal to the amount on the treated turf.

5)   Activities on treated turf occur for 2 hours per day. One of these occurs at the level measured one hour after treatment and the other at that measured 2 hours after treatment. **This should be considered to be conservative because it does not address the dissipation of the material during the activity period itself.** It is also conservative in that it assumes that activities begin soon after the application. It is common to require that the area be vacated until the turf is dry, often a period of 2 hours.

The oral exposure was calculated by the following equation:

$$\text{Exposure (µg/kg/day)} = \frac{\text{TTR (ng/cm}^2) \times 350 \text{ cm}^2 \times 1.56 \text{ activities/hr} \times 2 \text{ hr/day}}{1000 \text{ ng/µg} \times 15 \text{ kg body weight}}$$

It was assumed that 1 hour of activity occurs at the residue levels found 1 hour after treatment and one at the levels found 2 hours after treatment. The estimated hand to mouth, dermal and total exposures are presented in Table 5.

Table 5. Estimates of the Daily Oral Exposure from Hand to Mouth Activity and Dermal Exposures of Individuals Performing Activities on Turf Treated with DDVP at a Rate of 0.5 lb per Acre. Individuals are assumed to spend 2 hours per day, on occurring one hour after treatment and one two hours after treatment.

Location	TTR (ng/cm²)		Hand to Mouth[1] Exposure (µg/kg/day)		Dermal Exposure[2] (µg/kg/day)		Total (µg/kg/day)	MOE
	After 1 Hour	After 2 Hours	After 1 Hour	After 2 Hours	After 1 Hour	After 2 Hours		
CA	5.34	0.68	0.194	0.025	0.344	Negligible[3]	0.56	180
	3.94	0.73	0.143	0.027	0.183	Negligible	0.35	280
	4.75	0.55	0.173	0.020	0.276	Negligible	0.47	210
Mean	4.68	0.65	0.17	0.024	0.268	Negligible	0.46	220
FLA	1.29	1.52	0.047	0.055	Negligible	Negligible	0.10	1000
	1.52	0.71	0.055	0.026	Negligible	Negligible	0.081	1200
	1.86	1.22	0.068	0.044	Negligible	Negligible	0.11	910
Mean	1.56	1.15	0.057	0.042	Negligible	Negligible	0.099	1000
ONT	23.73	5.79	0.864	0.211	2.459	0.396	3.9	26
	24.28	3.3	0.884	0.12	2.523	0.109	3.6	28
	18.47	4.4	0.672	0.16	1.854	0.236	2.9	34
Mean	22.16	4.5	0.807	0.16	2.279	0.248	3.5	29

[1] Hand to mouth exposure = $\dfrac{\text{TTRS (ng/cm}^2) \times 350 \text{ cm}^2 \times 1.56 \text{ activities/hr} \times 2 \text{ hr/day}}{1000 \text{ ng/µg} \times 15 \text{ kg body weight}}$

[2] Dermal Exposure = $\dfrac{[\text{TTRS (ng/cm}^2) \div 1000 \text{ ng/µg} \times 24400 \text{ -}57.3] \times 0.11 \times 20 \text{ min/activity} \times 3 \text{ activities/hr}}{70 \text{ kg}}$

[3] Negligible means that extrapolation using the regression equation from the carpet study yields a value slightly less than 0; considered to be no exposure.

Figure 1.
Total Residues of DDVP on Turf in Florida and Ontario
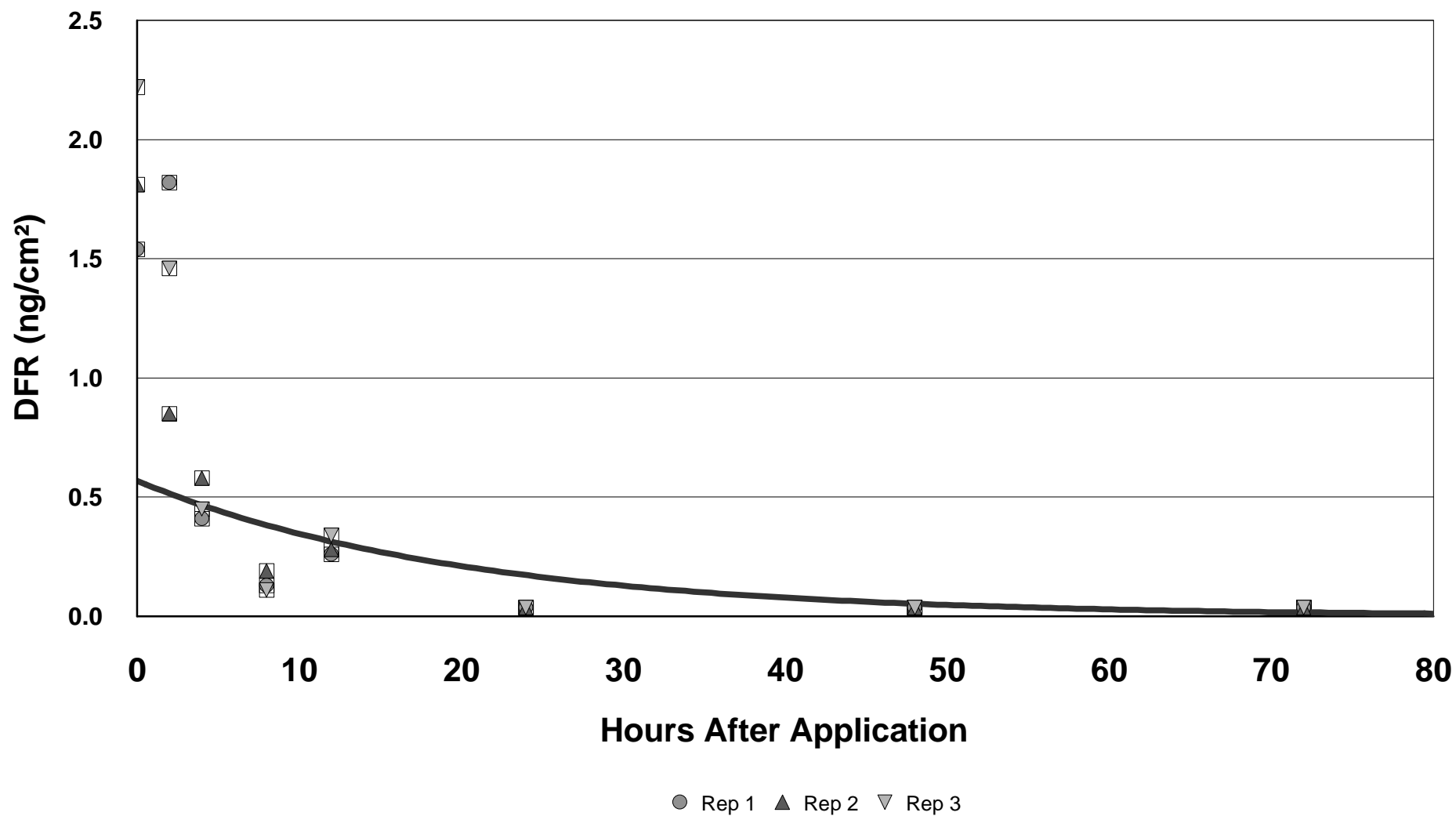**After Application at a Rate of 0.5 lb ai/A**
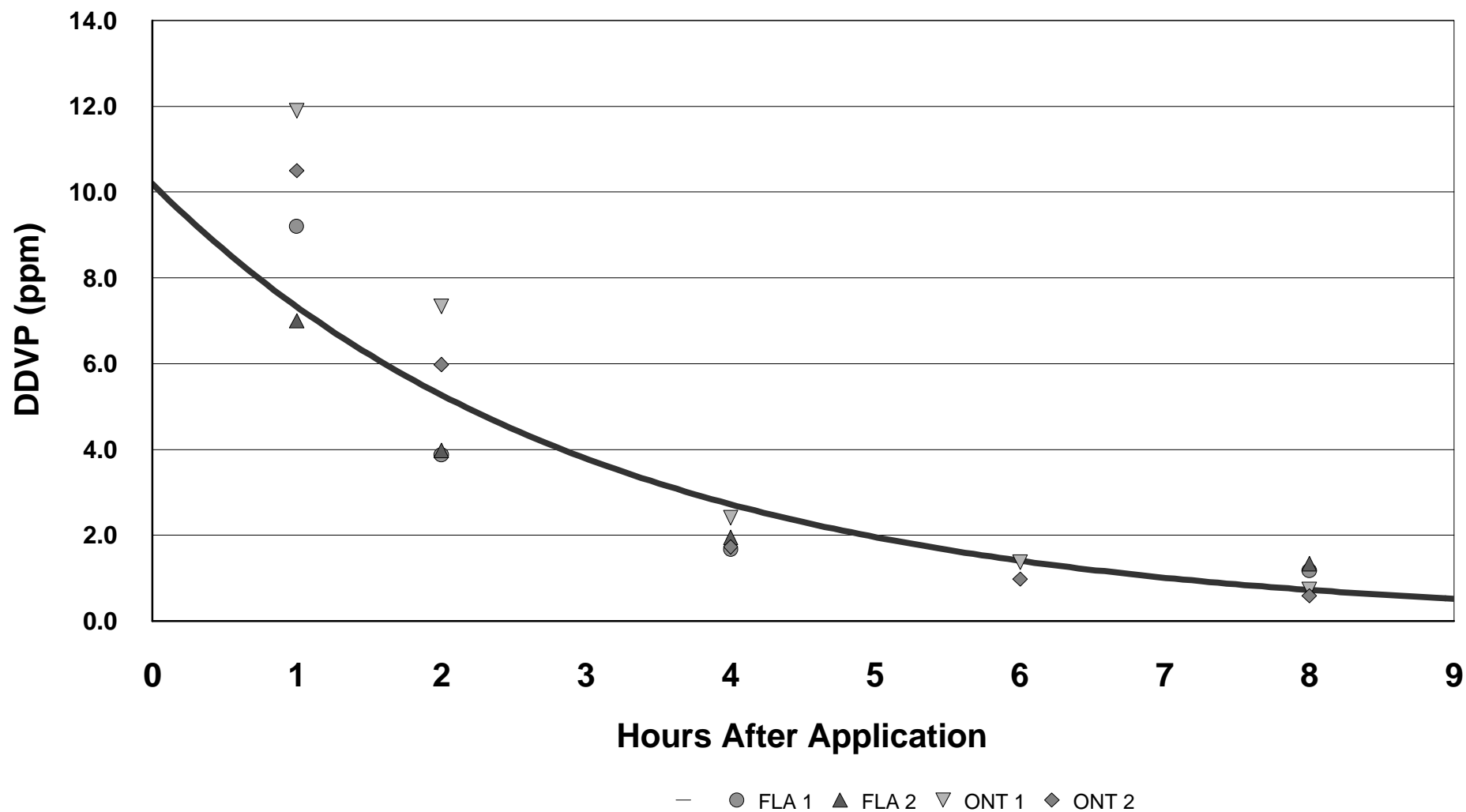
R-square = 0.867   # pts = 18
y = 10.2e^-0.33x

Figure 2
Dislodgeable Residues of DDVP on California Turf After
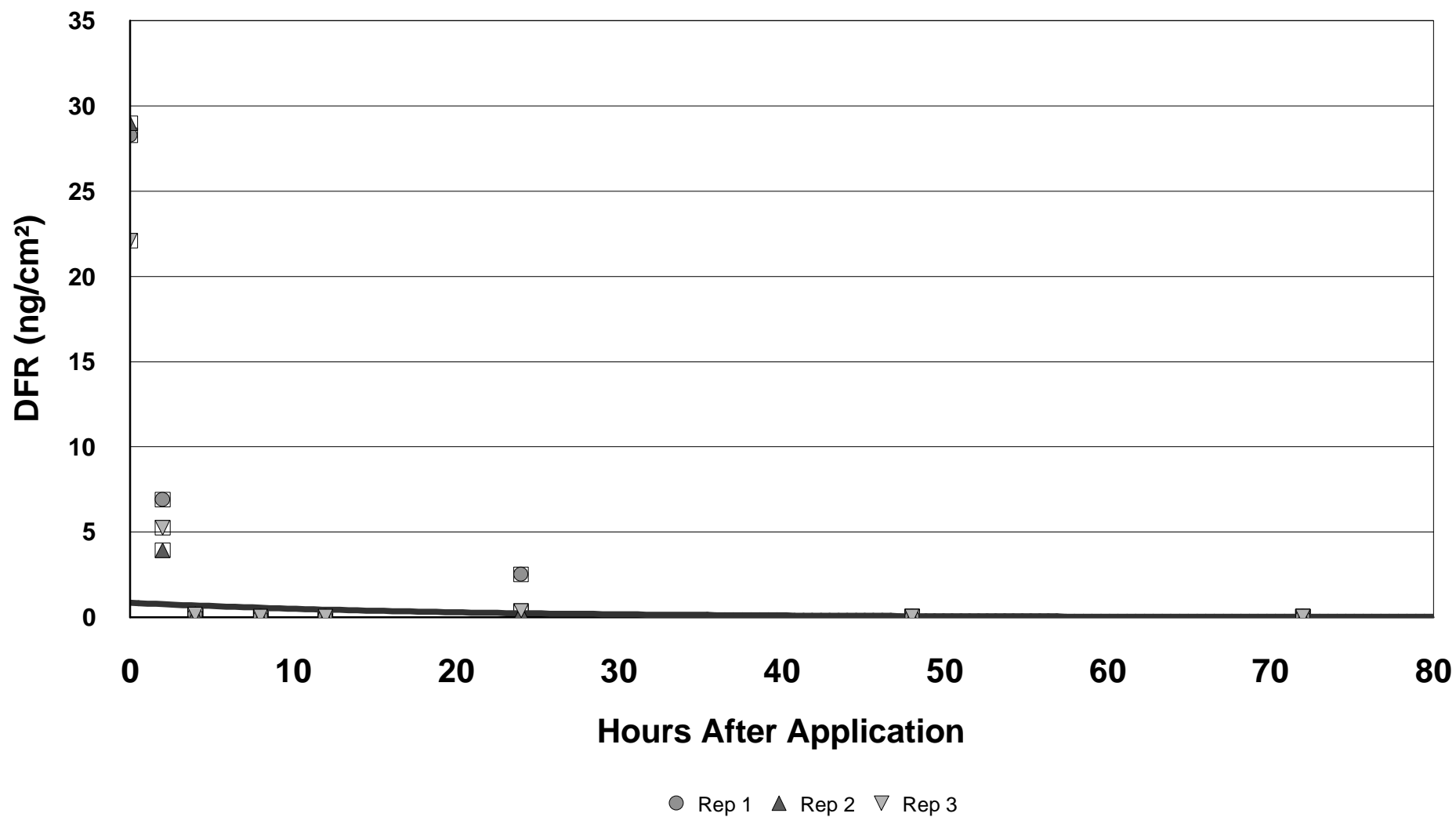**Application at a Rate of 0.5 lb ai/A**
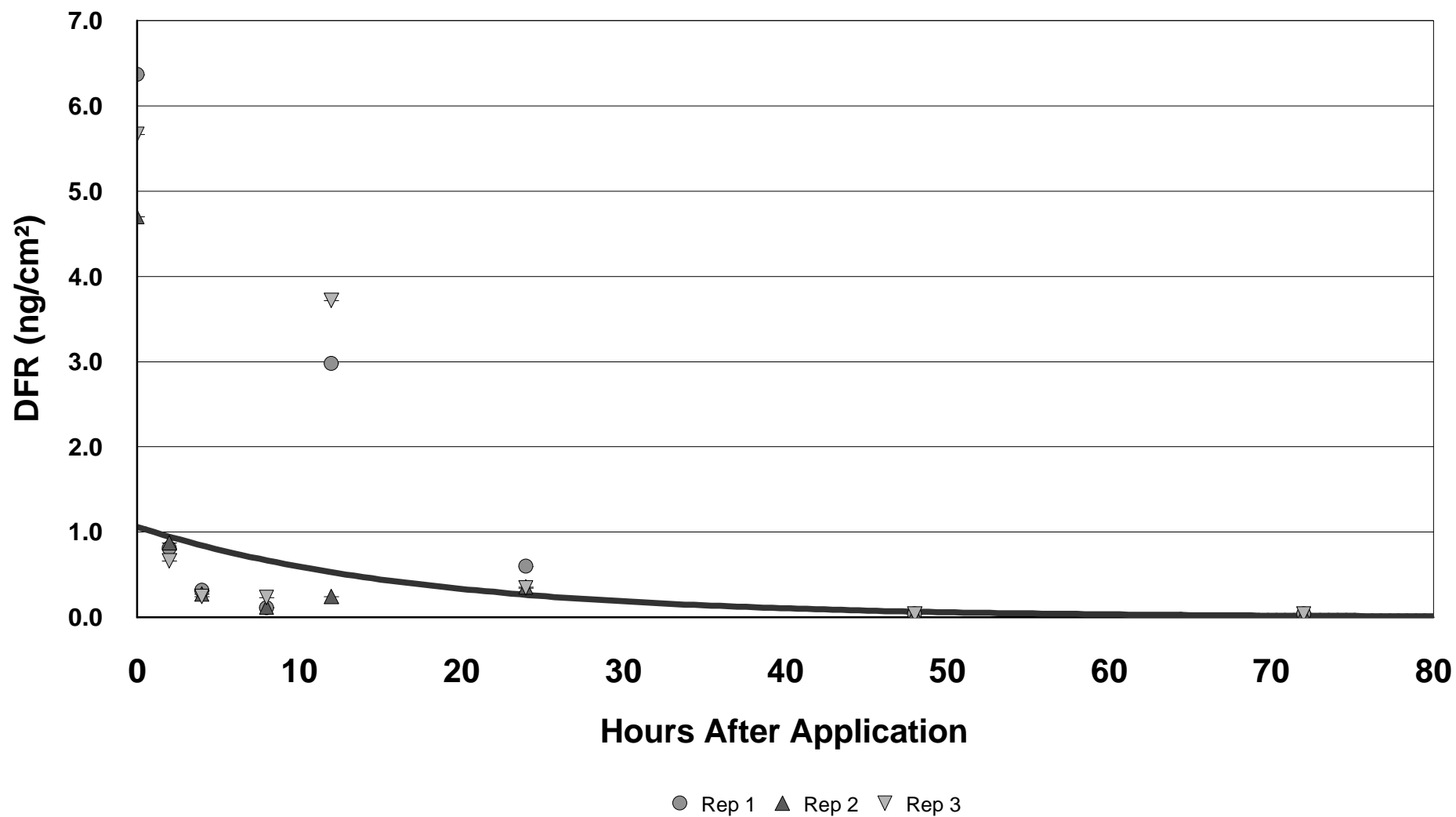
R-square = 0.595   # pts = 24
y = 1.06e^-0.058x

**Figure 3.
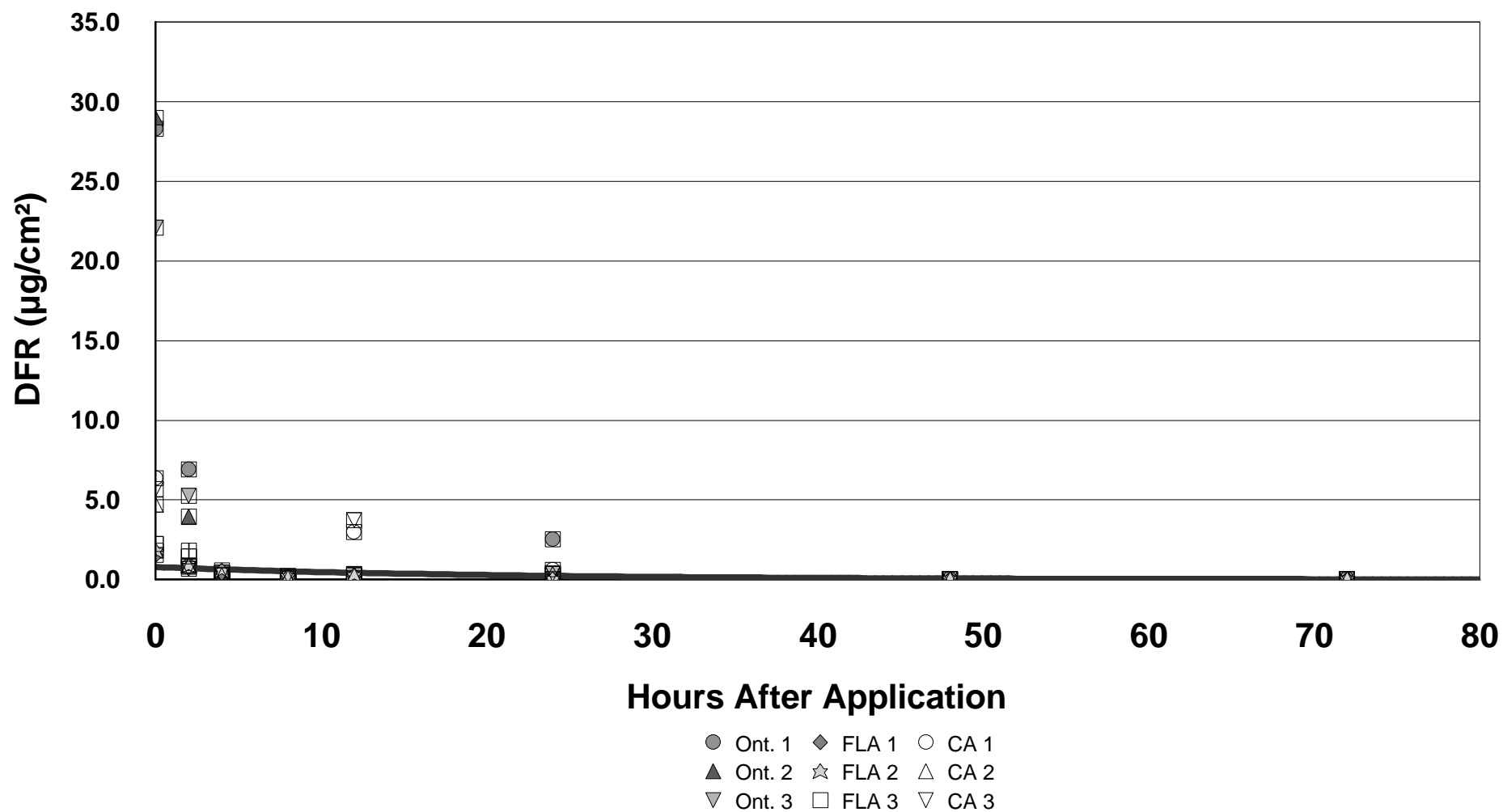Dislodgeable Residues of DDVP on Florida Turf After
Application at a Rate of 0.5 lb ai/A**

R-square = 0.633   # pts = 24
y = 0.569e^-0.0497x

**Figure 4.
Dislodgeable Residues of DDVP on Turf in Ontario After
Application at a Rate of 0.5 lb ai/A**
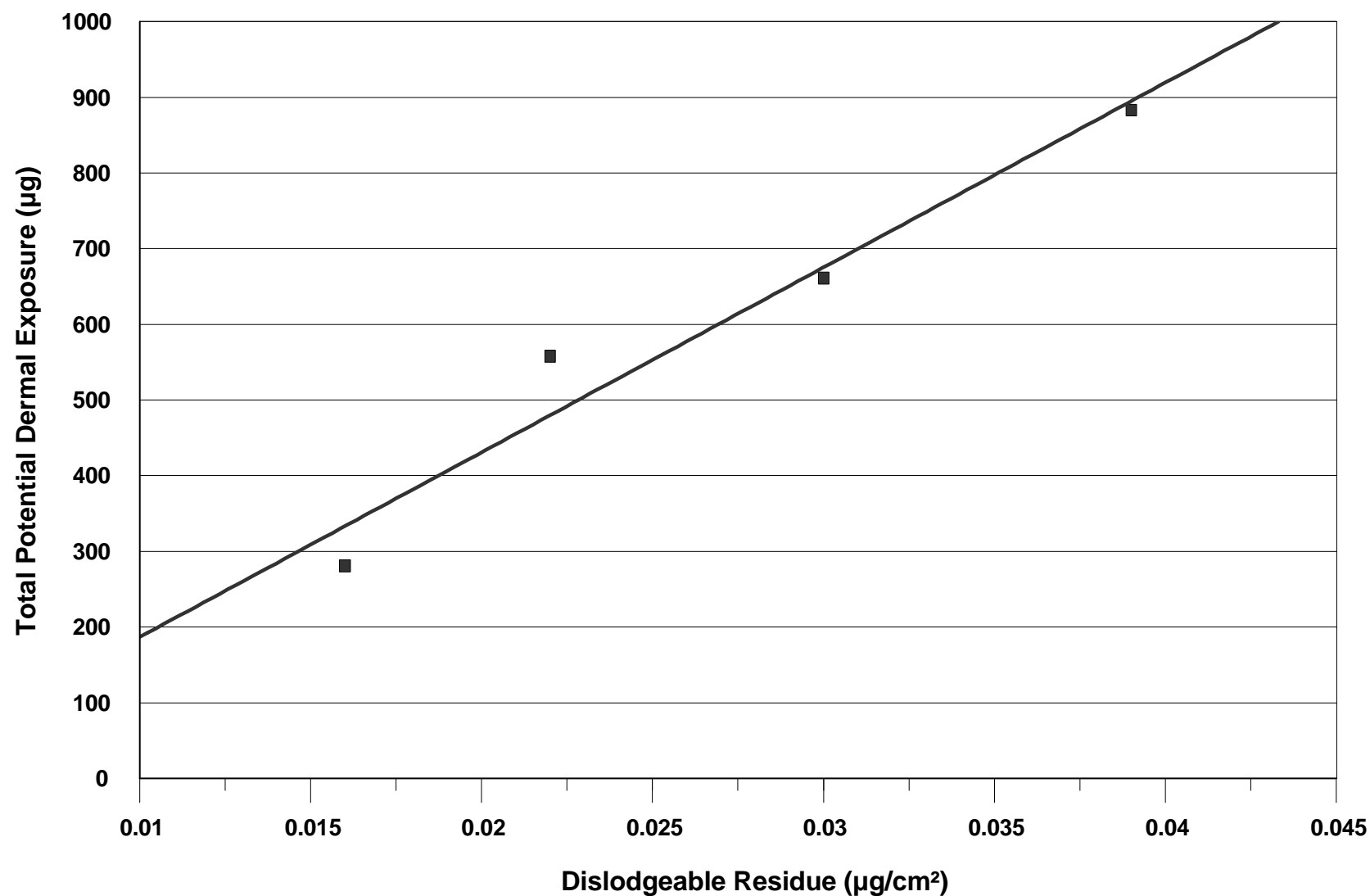
R-square = 0.288   # pts = 24
y = 0.852e^-0.0541x

Figure 5.
Dislodgeable Residues of DDVP on Turf After
Application at a Rate of 0.5 lb ai/A - Combination of All Sites

R-square = 0.423   # pts = 72
y = 0.785e^-0.052x

Figure 6. Correlation Between Dislodgeable Residues of DDVP and Total Potential Dermal Exposure After 20 Minutes of Exercise On Carpet Treated With a 0.5 Percent Fogger

R-square = 0.951   # pts = 4
y = -57.3 + 2.44e+004x

REFERENCES

1)   Memorandum from D. Jaquith (CEB2) to J. Rowland (RCAB) titled **"REENTRY EXPOSURES TO DDVP RESULTING FROM APPLICATION TO RESIDENTIAL TURF AND RECREATIONAL AREAS (PC Code 084001), (DP Code D246126)"**, dated March 16, 1998.

2)   Memorandum from D. Jaquith (CEB2) to J. Rowland (RCAB) titled "**RESPONSE TO COMMENTS FROM THE EXPOSAC AND OTHERS ON ASSESSMENT OF REENTRY EXPOSURES TO DDVP RESULTING FROM APPLICATION TO RESIDENTIAL TURF AND RECREATIONAL AREAS (PC code 084001), (DP Code D251909)**", dated January 28, 1999.

3)   Memorandum from D. Jaquith (OREB) to D. Utterback (SRB) titled "Assessment of Exposures of Residents to DDVP Applied as a Total Release Fogger", DP Code D166344, dated May 10, 1993.

4)   EPA, DRAFT Standard Operating Procedures (SOPs) for Residential Exposure Assessments, December 18, 1997.

5)   Federal Register Notice, September 28, 1995, Dichlorvos; Notice of Preliminary Determination to Cancel Certain Registrations and Draft Notice of Intent to Cancel, Page 50352.

cc: Dichlorvos file (084001)
      R. Kent (7509C)
      Correspondence file

Appendix A. Total DDVP Found in Grass Samples Following Application at a Rate of 0.5 lb/A.

Location	Interval (hrs)	Dilution Factor	Wt (g)	µg/mL	ppm found	ln(ppm)
FLA	1	100	10	0.18400	9.20	2.219
FLA	1	100	10	0.14000	7.00	1.946
FLA	2	100	10	0.07740	3.87	1.353
FLA	2	100	10	0.07950	3.98	1.381
FLA	4	100	10	0.03330	1.67	0.513
FLA	4	100	10	0.03890	1.95	0.668
FLA	8	25	10	0.09420	1.18	0.166
FLA	8	25	10	0.10700	1.34	0.293
ONT	1	400	10	0.05940	11.90	2.477
ONT	1	400	10	0.05240	10.50	2.351
ONT	2	400	10	0.03670	7.34	1.993
ONT	2	400	10	0.02990	5.98	1.788
ONT	4	50	10	0.09650	2.41	0.880
ONT	4	50	10	0.06920	1.73	0.548
ONT	6	1	10	2.74000	1.37	0.315
ONT	6	1	10	1.95000	0.98	-0.025
ONT	8	1	10	1.47000	0.74	-0.308
ONT	8	1	10	1.18000	0.59	-0.528

Exponential Regression Output:

Constant	2.322	$e^{2.322}$ = 10.2 ppm
Std Err of Y Est	0.360	
R Squared	0.866	
No. of Observations	18	
Degrees of Freedom	16	
X Coefficient(s)	-0.330177	
Std Err of Coef.	0.0323	

D248456, D248596, D255253

APPENDIX B.   **Section of the Residential Standard Operating Procedures for Residential Exposure Assessments**

2.3.2 Postapplication Potential Dose Among Toddlers from Incidental Nondietary Ingestion of Pesticide Residues on Residential Lawns from Hand-to-mouth Transfer

Introduction

   This SOP provides a standard method for estimating potential dose among toddlers from incidental ingestion of pesticide residues from previously treated turf. This scenario
assumes that pesticide residues are transferred to the skin of toddlers playing on treated yards and are subsequently ingested as a result of hand-to-mouth transfer. It does not include residues ingested as a result of soil ingestion (see Section 2.3.4). The method for estimating postapplication incidental ingestion dose from pesticide residues on turf is based on assumptions when adequate chemical specific field data are unavailable.

Methods for Estimating Potential Dose

Label information is important for selecting appropriate data inputs for the exposure assessment (see Section 2.0). The only datum required for estimating postapplication doses to pesticide residues on turfgrass is the application rate (e.g., lb ai/acre). The maximum application rate specified on the label should be used, except in cancer assessments when the typical application rates should be used. It should be noted, however, that the typical residential use rate is often the same as the maximum rate. The following assumptions are also needed for estimating pesticide postapplication doses.

On the day of application, it may be assumed that 20 percent (i.e., 0.20) of the application rate is available on the turfgrass as dislodgeable residue. This value is based on the professional judgement and experience of the OPP/HED staff from the review of company-submitted data and is believed to be an upper-percentile value. Postapplication activities must be assessed on the same day that the pesticide is applied since it is assumed that toddlers could play on the lawn immediately after application. For subsequent days after application, an assumed pesticide dissipation rate should be used, based on chemical-specific data.

The median surface area of both hands is 350 cm2 for a toddler (age 3 years). This value represents the mean of the 50th percentile total surface area values for males and females in the 2<3 year and 3<4 year age groups, multiplied by the mean percentage of the total body represented by hands for males and females. (U.S. EPA, 1996a). The 3 year old age group was selected for use in this scenario because this

is the youngest age group for which data on hand-to-mouth activity data were available.

Replenishment of the hands with pesticide residues is assumed to be an implicit factor in this assessment.   It is assumed that there is a one-to-one relationship between the dislodgeable residues on the turf and on the surface area of the skin after contact (i.e., if the dislodgeable residue on the turf is 1 mg/cm2, then the residue on the human skin is also 1 mg/cm2 after contacting the turf).

The mean rate of hand-to-mouth activity is 0.026 events/minute (i.e., 1.56 events/hr) for
toddlers (3 to 5 year olds) (U.S. EPA, 1996b).

The duration of exposure for toddlers is assumed to be 2 hours per day. This is based on the 95th percentile value (i.e., 121 minutes/day) for playing on grass for ages 1-4 years (U.S. EPA, 1996a).

Toddlers (age 3 years), used to represent the 1 to 6 year old age group, are assumed to weigh 15 kg. This is the mean of the median values for male and female children (U.S. EPA, 1996a).

Potential dose rates from ingestion are calculated as follows: $PDR_t = DFR_t * SA * FQ *$
$ET * CF1$

where:

PDR_t = potential dose rate on day "t" (mg/day)

DFR_t = dislodgeable foliar residue on day "t" (ug/cm2 turf)

SA = surface area of the hands (cm2/event)

FQ = frequency of hand-to-mouth activity (events/hr)

ET = exposure time (hr/day)

CF1 = weight unit conversion factor to convert ug units in the DFR value to mg for the daily exposure (0.001 mg/ug)

and $DFR_t = AR * F * (1-D)t * CF2 * CF3$
where:

AR = application rate (lbs ai/ft2 or lb ai/acre)
F = fraction of ai available on turf (unitless)

D = fraction of residue that dissipates daily (unitless)
t = postapplication day on which exposure is being assessed
CF2 = weight unit conversion factor to convert the lbs ai in the application rate to ug for the DFR value (4.54E8 ug/lb)
CF3 = area unit conversion factor to convert the surface area units (ft2) in the application rate to cm2 for the DFR value (1.08E-3 ft2/cm2 or 2.47E-8 acre/cm2 if the application rate is per acre)

Potential dose rates, normalized to body weight, are calculated as: PDRt-norm = PDRt / BW
where:

PDRt-norm = potential dose rate normalized to body weight on day "t" (mg/kg/day)
BW = body weight (kg)

Example Calculations

The following is an example calculation to determine the dose based on an assumed dislodgeable foliar residue. For the purpose of this example, the application rate is assumed to be 2.2E-5 lbs ai/ft2 (approximately 1 lb/acre). Thus, the dislodgeable foliar
residue on day 0 (i.e., the day of application) is as follows:

DFRt = AR * F * (1-D)t * CF2 * CF3

DFR0 = 2.2E-5 lb ai/ft2 * 0.2 * (1-D)0 * 4.54E8 ug/lb * 1.08E-3 ft2/cm2

DFR0 = 2.16 ug/cm2

The estimated incidental ingestion dose for a toddler on the day of application would be as follows:

PDRt = DFRt * SA * FQ * ET * CF1
PDR0 = 2.16 ug/cm2 * 350 cm2/event * 1.56 events/hr * 2 hr/day * 0.001 mg/ug
PDR0 = 2.36 mg/day

Finally, the estimated potential dose rate, normalized by body weight, for a toddler with a body weight of 15 kg would be:

PDRt-norm = PDRt / BW
PDR0-norm = (2.36 mg/day) / (15 kg)
PDR0-norm = 0.16 mg/kg/day

This dose would be used in conjunction with toxicity data to assess risk.

D248456, D248596, D255253

Limitations and Uncertainty

The dose estimates generated using this method are based on some upper-percentile (i.e., available residues, duration of exposure) and some central tendency (i.e., surface area, hand-to-mouth activity, and body weight) assumptions and are considered to be representative of high-end exposures. The uncertainties associated with this assessment stem from the use of an assumed amount of pesticide available from turf, and assumptions regarding dissipation and hand-to-mouth activity. The estimated doses are believed to be reasonable high-end estimates based on observations from chemical-specific field studies and professional judgement.

References

U.S. EPA (1996a) Exposure Factors Handbook. [Draft]. U.S. Environmental Protection Agency, National Center for Environmental Assessment, Washington, DC. EPA/600/P-95/002Ba.

U.S. EPA (1996b) Time location activity pattern methodology: the creation of Bayesian
distributions for the field investigations of exposure of infants and children to toxic substances. EPA-007-2. (To be included in an EPA Project Report entitled "Protocol for dermal exposure assessment in residential and non-occupational environments" which is currently in preparation and subject to EPA/ORD peer review).